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Movement patterns of adult Laughing Gulls *Larus atricilla* during the nesting season

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Abstract. The foraging behavior of birds is often influenced by the development and dietary needs of their young. Laughing Gulls in New Jersey, USA, nest in highly productive salt marshes but adults commonly forage at inland sites when they have young in the nest. I monitored movements of individual Laughing Gulls using color-marking, banding and radio-telemetry combined with land-based and aerial surveys. I found that breeding adults were highly mobile and commonly flew inland to forage. Color-marked individuals were observed a mean of 16.6 km and a median of 11.0 km from the colony. Radio-tagged birds were located as far as 40 km inland. Laughing Gulls showed foraging site tenacity both within a given year and from year to year. Radio-tagged adults made as many as 11 foraging trips from the colony per day during both diurnal and nocturnal periods. Activity at the colony peaked during late evening and morning hours. Furthermore, Laughing Gull movement patterns changed with progression of the nesting season. Gulls spent more time at the colony while incubating than during either the chick rearing or fledging periods.

Key words: Laughing Gull, *Larus atricilla*, movement, radio-telemetry, foraging

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INTRODUCTION

Movements and foraging patterns play critical roles in the distribution, ecology, and life history of birds. Species-specific foraging patterns and dietary requirements also influence avian habitat selection and distribution (Hildén 1965, Lack 1966, 1968, Buckley & Buckley 1972, MacArthur 1972, Burger 1985, Cody 1985, Zale & Mulholland 1985, Shealer 2002), and reproductive success (Murphy et al. 1984, Furness & Monaghan 1987, Bildstein et al. 1990, Watanuki 1992, Bukacińska et al. 1996). Furthermore, diet and foraging affect management approaches to both avian pest problems (Southern 1987) and conservation efforts (Bildstein 1993).

Several studies have reported that adults of some ibis (*Eudocimus* spp) and gull (*Larus* spp) species change diets when their young hatch (ffrench & Haverschmidt 1970, Jarvis & Southern 1976, Bildstein et al. 1982, Murphy et al. 1984, Annett 1987, Pierotti & Annett 1987, Annett & Pierotti 1989, Bildstein et al. 1990, Johnston & Bildstein 1990). These changes in diet and the related adult foraging habits are presumably in response to the special nutritional requirements of chicks (Furness & Monaghan 1987, Annett & Pierotti 1989, Pierotti & Annett 1990). A low salt diet is a nutritional requirement for nestlings of at least some species (ffrench & Haverschmidt 1970, Nyström & Pehrsson 1988, Bildstein et al. 1990, Johnston & Bildstein 1990). Thus, when their chicks hatch, these adult birds should switch from high salt foods (e.g., marine invertebrates) to low salt foods to minimize the osmoregulatory stress of their young. This could be done by changing from marine-based foods to inland foods of lower salinity.

There are several large, well established Laughing Gull nesting colonies on low lying salt marsh islands along the Atlantic Coast of New

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Jersey, USA (Kane & Farrer 1976, Jenkins et al. 1989). Adults commonly eat foods from marine and estuarine habitats (Caccamise et al. 1995). However, Laughing Gulls in these areas rarely feed their young foods from the productive salt marshes surrounding their colony (Dosch 1997a). Instead, nestlings are fed primarily foods from inland sources. Food items of inland origin, such as insects, fruit, and anthropogenic foods, have a lower salt content than many foods of marine origin (Schmidt-Nielsen 1960, Bildstein et al. 1990, Withers 1992, Bøkenes & Mercer 1995) and are therefore less likely to induce osmotic stress in nestlings.

I used color-marking and radio-telemetry to investigate the movements of adult Laughing Gulls during the nesting season. My goal was to determine if adults with dependent young in the nest traveled to inland foraging sites and if their movements changed as the season progressed.

METHODS

Study area

Research was conducted in Atlantic County, New Jersey, USA, during the breeding seasons (mid May to early August) of 1992, 1993, and 1994. The two study sites were a Laughing Gull nesting colony on Egg Island (39°28′N, 74°21′W), located within the Edwin B. Forsythe National Wildlife Refuge (FNWR), and Atlantic City International Airport/Federal Aviation Administration William J. Hughes Technical Center (ACY, 39°27′N, 74°35′W). Egg Island is a low lying salt marsh located approximately 19 km east of ACY and approximately 3.2 km from the mainland. ACY is an "island" of variable habitat within the predominantly homogeneous Pine Barrens region of southern New Jersey. The airport consists of approximately 2 200 ha of grassland, mixed oak scrub, and woods. It also contains developed areas associated with the airport's operations and two freshwater reservoirs covering approximately 57 ha (U.S. Fish and Wildlife Service 1993). I also conducted land-based surveys at several locations between the colony on Egg Island and ACY and flew an aerial survey route covering most of Atlantic County (see below).

Monitoring protocol

Each year, I marked nests with individually numbered survey flags. Nests were enclosed with 61 cm high erosion control fencing (woven polypropylene mesh) to keep nestlings within approximately 1.5 m of their nests. Beginning in May of each year I visited the colony two to five times per week throughout the nesting season and surveyed nesting activity, chick hatching, development, and fledging.

I defined three distinct periods within the annual nesting chronology: incubation, chicks, and fledging. The "incubation" period was defined as all dates from the day the first egg was found to the date on which 50% of all eggs had hatched; the "chicks" period included all dates from the date on which 50% of all eggs had hatched to the date on which 50% of all chicks had fledged; and the "fledging" period included all dates after which 50% or more of all chicks had fledged.

To plot nesting chronology versus date, I calculated values of nestling abundance, defined as the number of chicks present at the colony on a given date divided by the total number of chicks present over the course of the nesting season for that particular year. Thus, nestling abundance represents the percent of all chicks that remain at their nests (chicks that have hatched but not yet fledged) on a given date. This value takes into account both percent hatching and percent fledging.

Adult movements. In 1992 I color-marked breeding adults with one or more eggs in the nest from two sites within the nesting colony. I used a mixture consisting of Rhodamine-B (dye), silica gel (carrier), and isopropyl alcohol (fixative to improve feather retention of Rhodamine-B; see Belant & Seamans 1993). The actual color-marking technique consisted of placing a hard-boiled chicken egg in Laughing Gull nests with at least one egg. The dye mixture was then applied to the chicken egg (see Dosch 1996 for more details).

I also marked adults using standard leg bands and radio-transmitters (L. L. Electronics) with unique frequencies. This work was conducted under the regulations of USA federal and New Jersey state permits. Radio-transmitters were attached using a "backpack" harness, had a line of sight range of approximately 8 km, and expected lives of 2–4 months. The total transmitter packages weighed less than 5% of body mass. Each of these gulls was measured for sex determination using descriminant analysis (Dosch 1996).

In 1992 I captured, banded, and radio-tagged five adults at the colony. I also captured 16 adults at ACY. Each of these ACY birds was banded and dyed with Rhodamine-B and four were also radio-tagged. In 1993 I captured and banded 38 adult gulls at the colony and an additional 12 adults at ACY. Eleven of the gulls captured at the

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colony and all 12 captured at ACY were radio-tagged. Those captured at ACY were also marked with Rhodamine-B. In 1994 I captured, banded and color-marked a total of 51 adults at six different locations: 1) ACY, 2) a breeding colony (Egg Island), 3) a commonly used loafing area (Fish Island) in Great Bay just north of FNWR, 4) a clearing in a wooded portion of FNWR, 5) Hammonton Municipal Airport, Atlantic County, and 6) an agricultural pond near Hammonton (an agricultural town of 12 000 people located approximately 40 km inland from the colony). I also radio-tagged five of the birds captured at each of the first five sites.

I monitored movements of color-marked birds by conducting regular surveys at known and suspected inland foraging sites in the area between ACY and the nesting colony on Egg Island. To minimize possible time of day effects, I alternated survey starting times among 06:00, 10:00, and 14:00 (EST) and reversed the order in which the survey sites were visited. At each survey site I made visual observations over a three min period and counted the total number of Laughing Gulls present. I recorded the number of adults, sub-adults, young-of-the-year and color-marked individuals present at that site, and recorded their activities. To supplement survey data, I solicited reports of color-marked birds from the general public, the staff of FNWR, personnel of the New Jersey Division of Fish, Game and Wildlife, and the bird hazard reduction teams at ACY and John F. Kennedy International Airport (Kennedy Airport), Queens County, New York.

I monitored movements of radio-tagged gulls by conducting regular surveys throughout Atlantic County. In 1992 I combined these surveys with those for color-marked gulls. In 1993 and 1994 I extended the search area covered to include sites as far west of ACY as the town of Hammonton and its surrounding 2 400 ha of agricultural fields (primary crop is highbush blueberry *Vaccinium corymbosum*). At each survey site I made visual observations over a three min period as described above. At the end of the observation period I conducted a radio-sweep of the site to determine if any radio-tagged birds were present and noted the relative signal strength (as an indication of distance to the radio-tagged bird) and compass bearing.

I also conducted aerial surveys to locate radio-tagged gulls. Surveys were conducted using a fixed-wing aircraft following a flight plan that covered most of Atlantic County.

I used automatic data collection computers (hereafter, data-logger) to monitor the presence and absence of radio-tagged gulls at ACY and the colony during the 1993 and 1994 field seasons. The data-loggers were programmed to scan for the signal of each radio-tagged gull and a reference radio at fixed time intervals: 5 min intervals in 1993 and 15 min intervals in 1994. I increased the time interval in 1994 in order to extend data-logger battery life, and thus to increase the amount of data collected over time.

Data collected by the data-loggers were analyzed using SAS (SAS 1985) and a computer program developed for the purpose (see Dosch 1996). The program calculated the number of visits each radio-tagged bird made to a given location per day, the total number of minutes it spent at that location per day, and the time of day at which each of these events occurred. I compared data by sex of radio-tagged bird, location, and period of nesting chronology using analysis of variance (ANOVA) and Duncan's Multiple Range Test (Sokal & Rohlf 1981). Data representing the mean number of radio-tagged Laughing Gulls recorded at the colony and ACY per hour were also analyzed using ANOVA and Duncan's Multiple Range Test (Sokal & Rohlf 1981, SAS 1985).

RESULTS

I observed widespread courtship and mating behaviors throughout the colony on Egg Island when I began my surveys during the second week of May each year. I always found the first nests and eggs in mid-May and the first chicks in early June (Fig. 1).

Each year I began seeing young-of-the-year flying low over the colony and swimming in the creeks in and around the colony by mid- to late-July. These activities clearly signaled the start of the fledging period. Once begun, the number of young leaving their nests increased rapidly (Fig. 1).

By the first week in August I frequently observed mixed flocks of adults and fledglings foraging together at inland sites, often at considerable distances from the colony. On 14 July 1993 the bird hazard reduction team shot the first fledgling of the year at ACY (approximately 19 km from the colony) and I observed a fledgling flying 40 km inland from the colony on 21 July 1994.

Movements of adult gulls

In 1992 I color-marked breeding adults at 1 956 nests. I recorded 112 sightings of color-marked gulls from all sources (regular surveys,

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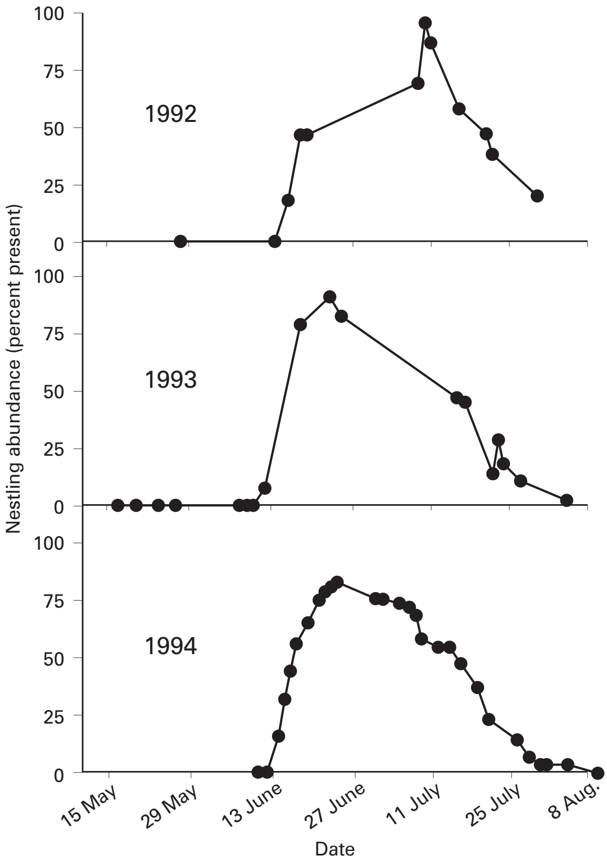

Fig. 1. Nesting chronology at the colony on Egg Island (FNWR) — percent of total nestlings hatched that were present during each survey at the colony

sightings by general public, etc.). Most of these observations were made within 10–15 km from the colony (Fig. 2) and were located in Atlantic County and on Long Beach Island, Ocean County (a barrier beach island north of and adjacent to FNWR). Sightings made during regular surveys were most common at distances of 6–11 km from the colony. This pattern was likely independent of the number of survey points at various distances because the distributions for these two variables (number of sightings and location of survey points) versus distance from the colony were quite different and because the same number of surveys were conducted at each location (Fig. 2).

The mean distance from the colony for all observations of color-marked gulls was 16.6 km and the median distance was 11.0 km. I recorded sightings of color-marked gulls as far as 24 km inland and 45 km out over the Atlantic Ocean (observation made from a fishing boat). The longest documented distance flown was approximately 145 km north to Kennedy Airport where one color-marked bird was shot by the bird hazard reduction team. An additional ten color-marked gulls were collected by the bird hazard reduction team at ACY. Inland foraging by adults nesting on Egg Island was confirmed by observations of these color-marked individuals (see also Caccamise et al. 1995).

To track movements of specific individuals I mounted 56 radio-transmitters on adults during the course of my study and made a total of 990 "sightings" of radio-tagged birds during ground and aerial surveys. I was able to locate 52 of the radio-tagged birds on a regular basis. Of these 52 individuals, 20 had been captured at the colony on Egg Island. An additional 12 radio-tagged birds captured elsewhere were regularly recorded at the colony and likely nested there.

I found that radio-tagged gulls commonly flew inland to forage. This data further corroborated inland foraging as suggested by my observations of color-marked individuals. I confirmed inland habitat use by 46 of the 52 radio-tagged gulls that were consistently located during surveys (7 in 1992, 19 in 1993, and 20 in 1994). Individuals frequently used various foraging sites associated with human activities. These included agricultural areas, tourist sites, fast-food restaurants, and airports.

Through my aerial surveys, I discovered that radio-tagged birds commonly foraged at great distances from the nesting colony. Twelve radio-tagged gulls were found in agricultural fields, orchards, and blueberry fields near the town of Hammonton, approximately 40 km inland from the colony.

I also used a data-logger to automatically monitor for the presence of radio-tagged gulls at the colony and ACY. The data-logger recorded the times at which each radio-tagged individual was present at the given location. Recordings at the colony indicated that birds came and went during all hours of the day and night (Fig. 3). The number of radio-tagged gulls present at the colony peaked between late afternoon and early morning and was lowest near noon ($F_{23\,1157} = 2.02$, p = 0.0029, α = 0.05, Fig. 3). Recordings at ACY also indicated that Laughing Gulls visited or passed over the airport during both daylight and nighttime hours. Unlike activity at the colony, there appeared to be no regular pattern in activity at ACY. There were no differences in the number of signals of radio-tagged gulls recorded at the airport during any hour.

I compared the number of visits and time spent at the colony per day by all radio-tagged

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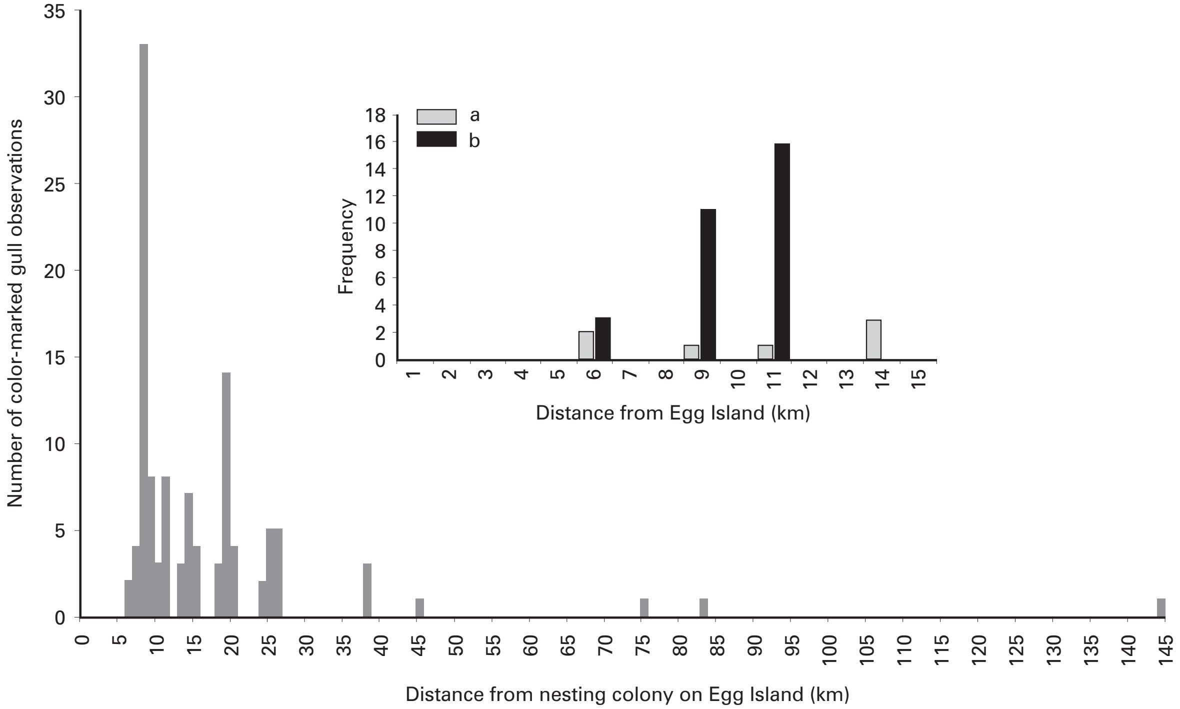

Fig. 2. Observations of color-marked birds presented as a frequency distribution according to distance from the nesting colony on Egg Island. Inset — position and distribution of survey sites relative to gull observations. a — frequency of survey sites, b — frequency of gulls observations.

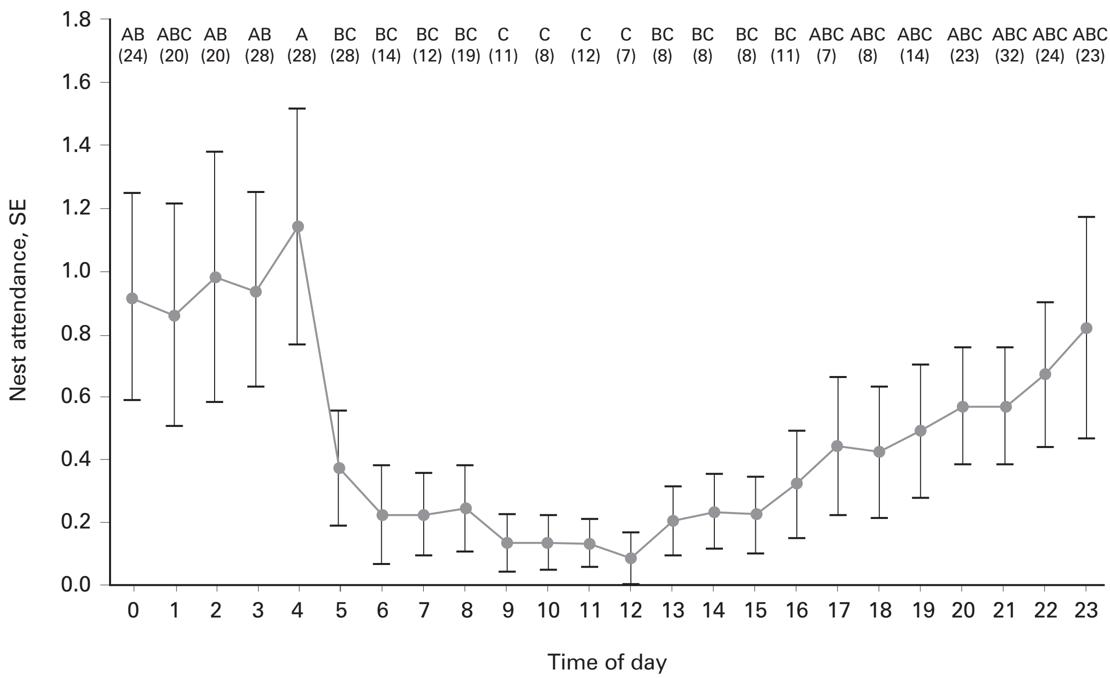

Fig. 3. Nest attendance — mean number of signals recorded by data-logger for radio-tagged gulls present at the colony. Means with different letters are significantly different ($F = 2.02$, df = 23/1157, $p = 0.0029$).

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gulls (both sexes combined) during the incubation, chick-rearing, and fledging periods of the 1993 and 1994 nesting seasons. I found no significant difference in the number of visits radio-tagged gulls made to the colony during any period of either year. I also found no significant difference in the amount of time radio-tagged individuals spent at the colony during any period of the 1993 nesting season. However, there were significant differences in the amount of time spent at the colony during various periods of the 1994 nesting season ($F_{2\ 50}$ = 14.67, p = 0.0001). Radio-tagged gulls spent more time at the colony during the incubation period (mean visit duration was 289 min) as compared to chick-rearing (110 min) or fledging (53 min) periods. There was no significant difference in time spent at the colony during the chick-rearing or fledging periods.

I also compared the number of visits and time spent at the colony per day by males versus females during the different periods of each nesting season. In 1993, I found that males spent more time at the colony during chick-rearing and fledging periods than females (Table 1). There were no significant differences in the amount of time either sex spent at the colony during either the incubation period of 1993, nor during any of the time periods of the 1994 nesting season. I found no significant differences in the number of visits either sex made to the colony during any period of the 1993 nesting season. However, males did make more visits to the colony than females during the 1994 chick-rearing period ($F_{1\ 53}$ = 8.44, p = 0.0053). There were no significant differences during the 1994 incubation or fledging period.

Table 1. Comparison of colony visits between sexes for radio-tagged gulls in 1993. Mean duration (min) of visits per radio-tagged bird per day to the colony during each period of the breeding season. Within each row, means with different letters are significantly different at the stated level.

Period	Male	Female	*F*	p
Incubation	116.50 A	132.00 A	0.02	0.8860
Chicks	157.83 A	42.22 B	4.77	0.0496
Fledging	158.33 A	55.25 B	7.15	0.0318

I compared the number of visits and time spent at ACY per day by all radio-tagged gulls (both sexes combined) during the incubation, chick-rearing, and fledging periods of the 1994 nesting season. I found no significant difference in number of visits gulls made to the airport during the different periods. However, there were differences in the amount of time radio-tagged birds spent at ACY during the three periods of the nesting season ($F_{2\ 302}$ = 12.99, p = 0.0001). Gulls spent more time at ACY during incubation as compared to the chick-rearing or fledging periods. I found no significant difference in time spent at the airport during either the chick-rearing or fledging periods.

I also compared the number of visits and time spent at ACY per day by males versus females during the different periods of the 1994 nesting season. I found that females made more visits to ACY during the fledging period than males (Table 2); however, males and females spent the same amount of time at the airport during that period ($F_{1\ 64}$ = 3.44, p = 0.0683). I found no differences between sexes during either the incubation or chick-rearing stage (Table 2).

Table 2. Comparison of visits to Atlantic City International Airport (ACY) by radio-tagged gulls in 1994. Mean number of visits per radio-tagged bird per day at ACY during each period of the breeding season. Within each row, means with different letters are significantly different at the stated level. Total — sexes combined.

Period	Total	Male	Female	*F*	p
Incubation	1.44			0.27	0.6139
Chicks	1.21			0.91	0.3446
Fledging		1.08 A	1.23 B	4.16	0.0455

I compared the number and duration of visits per day made by radio-tagged gulls (sexes combined) at the colony versus ACY in 1994. I found that radio-tagged individuals spent more time at the colony than the airport during each of the three nesting season periods (Table 3). Gulls also made more visits to the colony during both

Table 3. Comparison of visits to Atlantic City International Airport (ACY) and the colony on Egg Island by radio-tagged gulls in 1994. Mean duration (min) of visits per radio-tagged bird per day during each period of the breeding season. Within each row, means with different letters are significantly different at the stated level.

Period	ACY	Colony	*F*	p
Incubation	33.40 A	289.08 B	18.00	0.0005
Chicks	23.37 A	109.57 B	28.45	0.0001
Fledging	19.05 A	52.81 B	21.11	0.0001

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the chick-rearing and fledging periods (Table 4). There was no significant difference in the number of visits gulls made to either site during the incubation period (Table 4).

Table 4. Comparison of visits to Atlantic City International Airport (ACY) and the colony on Egg Island by radio-tagged gulls in 1994. Mean number of visits per radio-tagged bird per day during each period of the breeding season. Within each row, means with different letters are significantly different at the stated level.

Period	ACY	Colony	F	p
Incubation	1.44 A	2.30 A	3.10	0.0955
Chicks	1.21 A	3.06 B	28.92	0.0001
Fledging	1.16 A	2.10 B	10.72	0.0021

Banding recoveries

During the course of this study I banded 480 Laughing Gulls, including 352 chicks and 128 adults and sub-adults. A total of seven band recoveries were reported to the Bird Banding Lab. Three gulls were collected by the bird hazard reduction team at ACY and one was shot by the bird hazard reduction team at Kennedy Airport. The gull collected at Kennedy airport and two of those collected at ACY had been banded at the colony on Egg Island. The third individual shot at ACY had been banded at that airport three years earlier. One of my radio-tagged birds was also recovered dead in Georgia in January 1995. I had banded, color-marked, and radio-tagged this adult on Fish Island, Great Bay in early June 1994. It was recorded as being present at both ACY and the colony on Egg Island on several occasions.

Foraging site tenacity

Gulls I radio-tagged showed tenacity to specific foraging sites. For example, in 1992 I located specific foraging sites for two radio-tagged gulls in Atlantic City. Both gulls used foraging sites along the boardwalk where tourists were often seen feeding birds. One of these birds returned to the same foraging site on at least 11 out of 14 survey days before leaving the Atlantic County area. The other gull used the same foraging site on at least six out of nine survey days before it left the area. Similarly, in 1993 one of the radio-tagged gulls was located at the same foraging site along the FNWR Wildlife Drive on 22 of 25 surveys conducted during the nesting season. This included being present at the same foraging site on 19 of 19 surveys conducted during the period when Laughing Gulls had dependent young in the nest.

DISCUSSION

I found that Laughing Gulls nesting on Egg Island were members of a highly mobile population. Although they were nesting on a highly productive salt marsh island, adults commonly foraged at inland habitats up to 40 km from their colony. The stomachs of adults collected at one of these foraging areas, ACY, contained predominantly foods from inland habitats: insects, fruit, and anthropogenic foods (Caccamise et al. 1995). These foods also composed the majority of the diet for nestlings on Egg Island (Dosch 1997a).

Breeding adults color-marked at their nests on Egg Island used numerous inland foraging areas. Observations of color-marked birds occurred at an average distance of 16 km from the colony. Ten of these gulls were collected at ACY, approximately 19 km from the colony, and one individual was sighted 24 km inland from the colony. I found that gulls nesting on Egg Island actually flew much further inland than the color-marking results suggested. Radio-tagged individuals often traveled 40 km from the nesting colony. Bertellotti et al. (2001) reported a foraging distance of approximately 55 km for Kelp Gull *Larus dominicanus* traveling between their colony and waste tips. However, Laughing and Kelp gulls travel considerably further than the maximum foraging distance of 18.5 km recorded for Black-headed Gulls *Larus ridibundus* (Gorke & Brandl 1986) or the mean distance of 17.9 km traveled by adult Herring Gulls *L. argentatus* or the mean distance of 25.3 km traveled by adult Ring-billed Gulls *L. delawarensis* (Belant et al. 1998).

My observations of color-marked, radio-tagged, and banded Laughing Gulls demonstrated that individuals show foraging site tenacity within a given year. They also tend to use the same area year after year. For example, a bird I banded at ACY in 1992 was again using the airport as a foraging site when it was collected there in 1995. Foraging site tenacity has been demonstrated in several other colonial species. For instance, Herring Gulls (Davis 1975, Morris & Black 1980), and Grey Herons *Ardea cinerea* (Marion 1989) show foraging site tenacity with individuals using the same foraging site or a limited foraging area over long periods of time.

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Individuals can reduce the probability of fruitless searches by consistently foraging at locations where food sources have been predictable in the past (Gorke & Brandl 1986).

I found that Laughing Gulls left their colony for as many as 11 foraging trips per day. The daily activity patterns I recorded for radio-tagged individuals on Egg Island were quite similar to those previously recorded for Laughing Gulls in New Jersey (Burger 1976). I found that activity at the colony peaked between late evening and early morning. Conversely, the mean number of radio-tagged gulls present was lowest during late morning and afternoon hours. Burger (1976) also recorded numbers of Laughing Gulls present at a colony in FNWR (then named Brigantine NWR). She noted two peaks in activity (07:30 and 19:30, EST) during the 14-day period prior to egg laying and recorded the lowest number of gulls present at the colony late in the morning (about 11:30). During the egg laying period, more pairs were on their territories in the morning (06:00–09:00) than from 11:00–14:00 or from 16:00–19:00 (Burger 1976). These activity patterns observed for Laughing Gulls are different from those for Herring Gulls. Radio-tagged Herring Gulls did not show diurnal changes in activity at the colony (Belant et al. 1993). Rather, the presence of marked birds at the nest site was generally constant throughout the day.

Foraging trips of Laughing Gulls were not restricted to daylight hours. I found that gulls also made foraging trips away from the colony during the night. Radio-tagged individuals were often recorded at ACY during night-time hours. Also, insect species that are nocturnally active and attracted to lights (e.g., June beetles *Phyllophaga* spp., ground beetles Carabidae, Borror & White 1970, Stokes 1983), were present in diet samples of adults collected at the airport and nestlings at the colony (Caccamise et al. 1995, Dosch 1997a). The Atlantic City casinos are approximately 14 km from the colony on Egg Island and well within typical flight distances recorded for Laughing Gulls in this study. On several occasions I made casual night-time observations of hundreds of Laughing Gulls hawking for insects attracted to the casino spotlights (J. Dosch, unpubl. data). These bright lights were easily visible from the colony and insects are a major component of Laughing Gull diet (Caccamise et al. 1995, Dosch 1997a). Thus, the casino lights may have acted as both a reliable attractant of insect prey for birds nesting on Egg Island and a navigational aid for gulls flying back and forth between Atlantic City and the colony. Hartlaub's Gulls *Larus hartlaubi* have also been found to feed on insects attracted to lights at night (Shaughnessy 1977, Simon 1984).

The nocturnal movements and foraging I recorded for Laughing Gulls are rare among gulls in general, but in agreement with other research on this particular species (Burger & Staine 1993, McNeil et al. 1993). Burger & Staine (1993) monitored nocturnal activity of Laughing Gulls at Brigantine Beach, Atlantic County, during the nesting season. They found that an average of 27% of the gulls they observed at night were actively foraging. These Laughing Gulls were likely breeding birds nesting in nearby FNWR.

Recordings of radio-tagged Laughing Gulls at ACY had a less obvious diurnal pattern than that noted at the colony. When compared to activity at the colony, there were relatively low numbers of gulls at ACY at all times. Also, radio-tagged birds made fewer visits to the airport and spent less time there versus the colony. However, as recorded at the colony, gulls were present at ACY during both daylight and nighttime hours.

Movement patterns of radio-tagged Laughing Gulls also changed with the progression of the nesting season. Overall, gulls spent more time at the colony during the incubation period than during either the chick-rearing or fledging periods in 1994. The amount of time breeding Herring Gulls spend at the colony also decreases as their nesting season progresses from incubation through fledging (Belant et al. 1993). I found few differences in either the number of visits to or time spent at the colony by males versus females during the nesting season. This suggests an equitable distribution of parental investment between the sexes. Laughing Gull pairs that equitably share parental investment have higher reproductive success than those with an unequal distribution (Wagner 1992). Radio-tagged male and female Herring Gulls have also shown equitability in nest-site attendance (Belant et al. 1993). An equitable distribution of parental activities has also been shown to be important to their reproductive success (Burger 1986, Morris 1987).

Movements of marked individuals demonstrated that Laughing Gulls nesting on Egg Island regularly forage at agricultural and open grassland habitats (e.g., ACY, Hammonton Municipal Airport) well inland from the colony. Furthermore, the number of adults present at such sites follows a seasonal pattern related to their nesting chronology at the colony. The number and duration of

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visits adults made to the colony and inland sites changed when chicks hatched and as they aged. Breeding gulls began foraging at ACY in appreciable numbers when nestlings hatched (Caccamise et al. 1995, this study). The number of adults using inland foraging areas increased as their nesting season progressed from incubation phase to hatching, and similarly, decreased as nestlings fledged from the colony. Dolbeer et al. (1993) and Dolbeer & Bucknall (1994) showed similar results for Laughing Gulls that nest in a colony adjacent to Kennedy Airport and fly over the airport in route to foraging areas within the metropolitan New York City area. Their data suggest that adults of both sexes use inland areas for foraging and that this behavior may be especially important for breeding adults (Dolbeer et al. 1993, Dolbeer & Bucknall 1994). Similarly, Belant et al. (1998) found that use of landfills as foraging sites by both Herring and Ring-billed Gulls increased from the incubation period through post-fledging.

The foraging behavior of adult birds is commonly influenced by the development of their nestlings (Fagerström et al. 1983). Furthermore, by influencing adult foraging patterns, nutritional requirements of nestlings may influence colony site selection (Johnston & Bildstein 1990). Assuming that inland foraging areas contribute significantly to their fitness, perhaps as a source of nutritious food for their young, Laughing Gulls should select colony sites that minimize flight costs and distance to suitable inland habitats while still providing protection from predators and flooding. Perhaps inland foraging areas are not an absolute necessity for colonies but rather make a potential colony site even more suitable. This suggestion is supported by the fact that the diet of Laughing Gull chicks is composed primarily of foods from inland habitats (Dosch 1997a) and they grow more slowly when given salt supplements (Dosch 1997b).

The locations of Great Blue Heron *Ardea herodias* colonies in Maine and British Columbia (Gibbs et al. 1987, Gibbs 1991, Butler 1995) are related to their position relative to good foraging habitats. Therefore, the availability of energetically profitable locations for colonies is not necessarily limited by the number of suitable nesting sites, but rather by the spatial relationship of their feeding areas, inland wetlands, to suitable colony sites (Gibbs 1991). Future studies should address whether the regional distribution of Laughing Gull colonies in coastal areas is similarly tied to the gulls' dependence on inland foraging areas.

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REFERENCES

Annett C. 1987. Proximate mechanisms affecting dietary switches in breeding gulls. Studies in Avian Biology 10: 102.

Annett C., Pierotti R. 1989. Chick hatching as a trigger for dietary switching in the Western Gull. Colonial Waterbirds 12: 4–11.

Belant J. L., Ickes S. K., Seamans T. W. 1998. Importance of landfills to urban-nesting Herring and Ring-billed Gulls. Landscape Urb. Plan. 43: 11–19.

Belant J. L., Seamans T. W. 1993. Evaluation of dyes and techniques to color-mark incubating Herring Gulls. J. Field Ornithol. 64: 440–451.

Belant J. L., Seamans T. W., Gabrey S. W., Ickes S. K. 1993. Importance of landfills to nesting Herring Gulls. Condor 95: 817–830.

Bertellotti M., Yorio P., Blanco G., Giaccardi M. 2001. Use of tips by nesting Kelp Gulls at a growing colony in Patagonia. J. Field Ornithol. 72: 338–348.

Bildstein K. L. 1993. White Ibis: Wetland wanderer. Smithsonian Institution Press, Washington & London.

Bildstein K. L., Christy R., DeCoursey P. 1982. Size and structure of a South Carolina salt marsh avian community. Wetlands 2: 118–137.

Bildstein K. L., Post W., Johnston J., Frederick P. 1990. Freshwater wetlands, rainfall, and the breeding ecology of White Ibises (*Eudocimus albus*) in coastal South Carolina. Wilson Bull. 102: 84–98.

Bøkenes L., Mercer J. B. 1995. Salt gland function in the common Eider Duck (*Somateria mollissima*). J. Comparative Physiol. B 165: 255–267.

Borror D. J., White R. E. 1970. A field guide to insects. Houghton Mifflin Co., New York.

Buckley F. G., Buckley P. A. 1972. The breeding ecology of Royal Terns *Sterna* (*Thalasseus*) *maxima maxima*. Ibis 114: 344–359.

Bukacińska M., Bukaciński D., Spaans A. L. 1996. Attendance and diet in relation to breeding success in Herring Gulls (*Larus argentatus*). Auk 113: 300–309.

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Burger J. 1976. Daily and seasonal activity patterns in breeding Laughing Gulls. Auk 93: 308–323.

Burger J. 1985. Habitat selection in temperate marsh-nesting birds. In: Cody M. L. (ed.). Habitat selection in birds. Academic Press, San Diego, pp. 253–281.

Burger J. 1986. Selection for equitability in some aspects of reproductive investment in Herring Gulls *Larus argentatus*. Ornis Scand. 18: 17–23.

Burger J., Staine K. J. 1993. Nocturnal behavior of gulls in coastal New Jersey. Estuaries 16: 809–814.

Butler R. W. 1995. The patient predator: Foraging and population ecology of the Great Blue Heron *Ardea herodias* in British Columbia. Canadian Wildlife Service, Occasional paper no. 86.

Caccamise D. F., Reed L. M., Delay L. S., Bennett K. A., Dosch J. J. 1995. Studies of bird airport associations directed at mitigation of bird strike hazards. Draft Final Report for project DFTA01-91-Z-02004. Prepared for Department of Transportation, Federal Aviation Administration, Atlantic City International Airport/FAA Technical Center.

Cody M. L. 1985. An introduction to habitat selection in birds. In Cody M. L. (ed.). Habitat selection in birds. Academic Press, San Diego, pp. 1–56.

Davis J. W. F. 1975. Specialization in feeding location by Herring Gulls. J. Animal Ecol. 44: 795–804.

Dolbeer R. A., Belant J. L., Sillings J. 1993. Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport. Wildlife Soc. Bull. 21: 442–450.

Dolbeer R. A., Bucknall J. L. 1994. Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport, 1991–1993. Proc. Bird Strike Comm. Europe 22: 375–396.

Dosch J. J. 1996. Influence of nestling diet and salt tolerance on adult movement and foraging patterns: Field studies of the Laughing Gull (*Larus atricilla*). PhD thesis, Rutgers Univ., New Brunswick, New Jersey.

Dosch J. J. 1997a. Diet of nestling Laughing Gulls in southern New Jersey. Colonial Waterbirds 20: 273–281.

Dosch J. J. 1997b. Salt tolerance of nestling Laughing Gulls: An experimental field investigation. Colonial Waterbirds 20: 449–457.

Fagerström T., Moreno J., Carlson A. 1983. Load size and energy delivery in birds feeding nestlings: Constraints on and alternative strategies to energy-maximization. Oecologia 56: 93–98.

ffrench R. P., Haverschmidt F. 1970. The Scarlet Ibis in Surinam and Trinidad. Living Bird 9: 147–165.

Furness R. W., Monaghan P. 1987. Seabird Ecology. Chapman and Hall, New York.

Gibbs J. P. 1991. Spatial relationships between nesting colonies and foraging areas of Great Blue Herons. Auk 108: 764–770.

Gibbs J. P., Woodward S., Hunter M. L., Hutchinson A. E. 1987. Determinants of Great Blue Heron colony distribution in coastal Maine. Auk 104: 38–47.

Gorke M., Brandl R. 1986. How to live in colonies: Spatial foraging strategies of the Black-headed Gull. Oecologia 70: 288–290.

Hildén O. 1965. Habitat selection in birds: a review. Ann. Zool. Fenn. 2: 53–75.

Jarvis W. L., Southern W. E. 1976. Food habits of Ring-billed Gulls breeding in the Great Lakes region. Wilson Bull. 88: 621–631.

Jenkins C. D. Jr., Niles L. J., Wessel J. 1989. Survey of colonial nesting waterbird species on the Atlantic Coast of New Jersey. Unpublished report, New Jersey Department of Environmental Protection.

Johnston J. W., Bildstein K. L. 1990. Dietary salt as a physiological constraint in White Ibis breeding in an estuary. Physiol. Zool. 63: 190–207.

Kane R., Farrer R. B. 1976. 1976 Coastal colonial bird survey of New Jersey. Occasional Papers, No. 125, New Jersey Audubon 2: 8–14.

Lack D. 1966. Population studies in birds. Claredon Press, London.

Lack D. 1968. Ecological adaptations for breeding birds. Chapman and Hall, London.

MacArthur R. H. 1972. Geographical ecology: Patterns in distribution of species. Harper and Row, New York.

Marion L. 1989. Territorial feeding and colonial breeding are not mutually exclusive: The case of the Grey Heron (*Ardea cinerea*). J. Anim. Ecol. 58: 693–710.

McNeil R., Drapeau P., Pierotti R. 1993. Nocturnality in colonial waterbirds: occurrence, special adaptations, and suspected benefits. Current Ornithol. 10: 187–246.

Morris R. 1987. Time-partitioning of clutch and brood care activities in Herring Gulls: A measure of parental quality? Stud. Avian Biol. 10: 68–74.

Morris R. D., Black J. E. 1980. Radiotelemetry and Herring Gull foraging patterns. J. Field Ornithol. 51: 110–118.

Murphy E. C., Day R. H., Oakley K. L., Hoover A. A. 1984. Dietary changes and poor reproductive performance in Glaucous-winged Gulls. Auk 101: 532–541.

Nyström K. G. K., Pehrsson O. 1988. Salinity as a constraint affecting food and habitat choice of mussel-feeding diving ducks. Ibis 130: 94–100.

Pierotti R., Annett C. 1987. Reproductive consequences of dietary specialization and switching in an ecological generalist. In: Kamil A. C., Krebs J., Pulliam H. R. (eds). Foraging Behavior. Plenum Publishing Corporation, New York, pp. 417–422.

Pierotti R., Annett C. A. 1990. Diet and reproductive output in seabirds. Bioscience 40: 568–574.

SAS Institute Inc. 1985. SAS/STAT ™ guide for personal computers, version 6 edition. SAS Institute Inc., Cary, NC.

Schmidt-Nielsen K. 1960. The salt-secreting gland of marine birds. Circulation 21: 955–967.

Shaughnessy P. 1977. Hartlaub's Gull nocturnal feeding. Promerops 129: 3–4.

Shealer D. A. 2002. Foraging behavior and food of seabirds. In: Schreiber E. A., Burger J. (eds). Biology of marine birds. CRC Press, Boca Raton, FL, pp. 137–177.

Simon D. 1984. Hartlaub's Gulls feeding at night on insects. Cormorant 3: 17.

Sokal R. P., Rohlf F. J. 1981. Biometry: The principles and practice of statistics in biological research, 2nd ed. W. H. Freeman, San Francisco.

Southern W. E. 1987. Gull research in the 1980s: Symposium overview. Stud. Avian Biol. 10: 1–7.

Stokes D. W. 1983. A guide to observing insect lives. Little, Brown and Company, Boston.

U.S. Fish and Wildlife Service. 1993. White-tailed deer population assessment at the Federal Aviation Administration Technical Center, Pomona, Atlantic County, New Jersey. Technical Assistance Report. Pleasantville, New Jersey.

Wagner L. A. 1992. Equitability of parental investment in laughing gulls. M.Sc. thesis. Rutgers, The State University of New Jersey, New Brunswick, New Jersey.

Watanuki Y. 1992. Individual diet difference, parental care and reproductive success in Slaty-backed Gulls. Condor 94: 159–171.

Withers P. C. 1992. Comparative animal physiology. Saunders College Publishing.

Zale A. V., Mulholland R. 1985. Habitat suitability index models: Laughing Gull. U.S. Fish and Wildlife Service Report 82(10.94).

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STRESZCZENIE

[Przemieszczenia dorosłych mew karaibskich w okresie lęgowym]

Przedmiotem badań, przeprowadzonych w okresie lęgowym lat 1992–1994 w stanie New Jersey (USA), były przemieszczenia mew śledzone metodami kolorowego znakowania, obrączkowania, telemetrii radiowej oraz obserwacji z ziemi i obserwacji lotniczych. Badaniami objęto dwa tereny: kolonię lęgową Egg Island usytuowaną w rezerwacie im. Edwin B. Forsythe (FNWR) oraz międzynarodowe lotnisko Atlantic City (ACY).

W kolonii, odwiedzanej 2–5 razy w tygodniu w ciągu całego sezonu lęgowego, rejestrowano przebieg lęgów. Ich nasilenie w czasie (Fig. 1) określano dzieląc liczbę piskląt w danym dniu przez liczbę piskląt w całym sezonie lęgowym danego roku.

Stwierdzono dużą aktywność przemieszczeń dorosłych gnieżdżących się ptaków — latały one w głąb lądu na żerowiska. Znakowane barwnie ptaki obserwowano średnio 16.6 (mediana 11.0) km od kolonii (Fig. 2). Telemetrycznie stwierdzano często ptaki na terenach rolniczych nawet w odległości 40 km. Badane mewy wykazywały przywiązanie do określonych żerowisk zarówno w ciągu danego sezonu jak też w kolejnych latach.

Na obu badanych terenach ptaki znakowane telemetrycznie były rejestrowane automatycznie (data-logger). Odbywały one ok. 11 lotów żerowiskowych na dobę, również w nocy (Fig. 3); o tej porze były rejestrowane jako przylatujące lub przelatujące m.in. na lotnisku ACY. W kolonii najwięcej ptaków przebywało między późnym popołudniem a rankiem, a najmniej — w godzinach południowych.

W sezonie 1993 stwierdzono, że samce spędzały więcej czasu w kolonii podczas wychowania piskląt i podlotów niż samice (Tab. 1). W sezonie 1994 stwierdzono, że samice (w porównaniu do samców) w okresie wychowania podlotów odbywały więcej lotów na lotnisko ACY, ale obie grupy spędzały tam podobną ilość czasu w tym okresie. Nie stwierdzono natomiast takich różnic w okresie wychowania piskląt (Tab. 2).

Porównanie dziennej liczby i czasu trwania wizyt śledzonych telemetrycznie mew w kolonii i na lotnisku ACY wykazało, że w 1994 r. spędzały one więcej czasu w kolonii (Tab. 3) w ciągu całego sezonu lęgowego. W okresie wychowania piskląt i podlotów zarejestrowano tu także wiekszą liczbę wizyt (Tab. 4).

Mewy karaibskie prawdopodobnie wybierają miejsca kolonii lęgowych pod kątem oszczędności przelotu do odpowiednich żerowisk śródlądowych, a także ze względu na bezpieczeństwo przed drapieżnikami i zalewaniem. Dietę ich piskląt stanowią głównie pokarmy ze środowisk śródlądowych (Dosch 1997a), a udział pokarmów zasolonych z morza opóźnia ich rozwój (Dosch 1997b).

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